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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Patent Application of

Peter Mardilovich et al.

Application No. 10/629,116

Filed: July 28, 2003

For: Fuel Cell Support Structure and Method of Manufacture

Group Art Unit: 1745

Examiner: LEE, Cynthia K.

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to Appellants' filing of an Appeal Brief on 26 April 2007, the Examiner of this application reopened prosecution with a non-final Office Action dated 11 July 2007 (the "Office Action" or the "Action"). Having reviewed the new grounds of rejection raised in the Office Action of 11 July, Appellants hereby request re-instatement of the appeal in this application and files the present, updated Appeal Brief, along with a new Notice of Appeal, in support of the re-instated appeal.

I. Real Party in Interest

The real party in interest is Hewlett-Packard Development Company, LP, a limited partnership established under the laws of the State of Texas and having a principal place of business at 20555 S.H. 249 Houston, TX 77070, U.S.A. (hereinafter "HPDC"). HPDC is a Texas limited partnership and is a wholly-owned affiliate of Hewlett-Packard Company, a Delaware Corporation, headquartered in Palo Alto, CA. The general or managing partner of HPDC is HPQ Holdings, LLC.

II. Related Appeals and Interferences

There are no appeals or interferences related to the present application of which the Appellants are aware.

III. Status of Claims

Claims 49-84 are pending in the application and stand finally rejected. Accordingly, Appellants appeal from the final rejection of claims 49-84, which claims are presented in the Appendix.

IV. Status of Amendments

No amendments have been filed subsequent to the final Office Action of 15 December 2006 or the non-final Office Action dated 11 July 2007, from which Appellants take this appeal.

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V. Summary of Claimed Subject Matter

Fuel cells conduct an electrochemical reaction with reactants such as hydrogen and oxygen to produce electricity and heat. (*Appellants' specification, paragraph 0001*). A typical fuel cell includes an electrolyte disposed between an anode and a cathode. (*Appellants' specification, paragraph 0002*). Appellants' specification describes a fuel cell support structure for the anode, cathode and electrolyte, and methods for fabricating fuel cell support structures. According to one exemplary implementation, a fuel cell support structure includes a self-organized ceramic substrate in which nanopores of selected morphology are defined. (*Appellants' specification, paragraph 0024*).

With reference to Appellants' Fig. 1, a fuel cell (100) generally includes a support structure (110), an electrolyte (120), an anode (130), and a cathode (140). The fuel cell support structure (110) supports the electrolyte (120), the anode (130), and/or the cathode (140). Fig. 1 illustrates an exemplary implementation of a dual chamber fuel cell (100) utilizing a self-organized nanoporous ceramic fuel cell support structure (110). As used herein, the term "self-organized" refers to the property of the material from which the support structure is made to form parallel nanopores when the support substrate is grown, micromachined or etched as described below. The support structure may be formed, for example, from anodic alumina. In the illustrated implementation, a dense layer of electrolyte (120) is disposed in the pores (150) in the support structure (110). Further, the anode (130) and the cathode (140) are disposed on opposing sides of the support structure (110), being separated by the support structure (110) and the deposited electrolyte (120). Thus, the combination of the support structure, the electrolyte (120), the anode (130) and the cathode (140) separate the two chambers of the fuel cell system (not shown). The structure and operation of the dual chamber fuel cell will be described in more detail below with reference

to Figs. 9-11. For dual chamber systems, efficiency may be affected by the need to seal two chambers from each other and by the ability to transfer ions from the cathode across the electrolyte to the anode. Precise control of the porosity characteristics of a support structure may allow for more precise formation of the electrolyte and/or electrodes on the support structure while providing for improved diffusion. (*Appellants' specification, paragraph 026*)

Turning to specific claims:

Claim 49 recites:

A fuel cell comprising:

a ceramic support substrate (110) supporting a cathode (140), anode (130) and electrolyte (120) (*Appellants' specification, paragraph 026*); and

a plurality of pores (150) formed through said substrate (110), said pores (150) having a size that varies in diameter through a thickness of said substrate (110) (*Appellants' specification, paragraph 0036 and Figs. 6 and 7*).

Claim 51 recites:

A fuel cell comprising:

a support substrate (110) supporting a cathode (140), anode (130) and electrolyte (120) (*Appellants' specification, paragraph 026*); and

a plurality of pores (150) formed through said substrate (110) (*Appellants' specification, paragraph 026*),

wherein said pores (150) vary in diameter by tapering to a narrow point (600) between two openings, both openings being larger than said narrow point (*Appellants' specification, paragraph 0036 and Figs. 6 and 7*).

Claim 58 recites:

An apparatus comprising:

a fuel cell configured for providing power (*Appellants' specification, paragraph 026*), said fuel cell comprising:

a support substrate (110) supporting a solid cathode material (140) deposited on a first side of said substrate (110), a solid anode material (130) deposited on a second side of said substrate (110) and an electrolyte (120) (*Appellants' specification, paragraph 026*); and

a plurality of pores (150) formed through said substrate (110), said pores (150) having a size and shape formed in accordance with a pre-selected desired porosity (*Appellants' specification, paragraph 026*).

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VI. Grounds of Rejection to be Reviewed on Appeal

The recent Office Action raised the following grounds of rejection:

(1) Claim 78 was rejected under 35 U.S.C. § 112, first paragraph, as lacking a supporting written description in the specification.

(2) Claim 58 was rejected under 35 U.S.C. § 112, second paragraph. Claims 55 and 57 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.

(3) Claims 49, 51, 58, 59, 65, 66, 68, 69, 76, 77, and 78 were rejected as anticipated under 35 U.S.C. § 102(b) by U.S. Patent No. 3,503,808 to Agruss ("Agruss").

(4) Claims 49, 58, 68, 70-72, 74, 75, 78-81, 83 and 84 were rejected as anticipated under 35 U.S.C. § 102(b) by U.S. Patent No. 5,234,722 to Ito ("Ito").

(5) Claims 52-57 were rejected as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Agruss and U.S. Patent App. Pub. No. 2002/01422414 to Pekala et al. ("Pekala").

(6) Claims 60-64 and 67 were rejected as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Agruss and Pekala.

(7) Claims 52-57 were rejected as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Ito and Pekala.

(8) Claims 60-64 and 67 were rejected as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Ito and Pekala.

(9) Claim 76 was rejected as being unpatentable under 35 U.S.C. § 103(a0 over the teachings of Ito in view of Hibino (of record).

(10) Claim 73 was rejected as being unpatentable under 35 U.S.C. § 103(a0 over the teachings of Ito in view of U.S. Patent No. 6,558,831 to Doshi ("Doshi").

(11) Claim 82 was rejected as being unpatentable under 35 U.S.C. § 103(a0 over the teachings of Ito in view of Doshi.

Accordingly, Appellants hereby request review of these grounds of rejection.

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VII. Argument

(1) Claim 78 complies with 35 U.S.C. § 112:

Claim 78 recites: "wherein each pore comprises a layer in which said electrolyte is mixed with a material of said substrate, said layer being between said electrolyte said substrate." According to the recent Office Action, there is no supporting written description in Appellants' specification for this subject matter. (Office Action p. 3). Appellants respectfully disagree.

As shown in Appellants' Fig. 2, each pore (150) is lined with an electrolyte layer (120). Paragraph 0027 of Appellants' specification explains that "[a] layer of electrolyte (120), which may be thinner than that required for the dual chamber implementation (100; Fig. 1), is disposed in the pores (150) of the support structure." (Appellants' specification, paragraph 0027). This electrolyte layer is shown by a solid black line in Fig. 2. The electrolyte layer is again illustrated with the same solid black line in Fig. 3, but is not indicated with a reference number in that figure.

As described in the corresponding portion of the specification and further illustrated in Fig. 3, there is a layer in which the electrolyte material is mixed with the material of the substrate that forms the supports structure, this region of mixing being clearly illustrated between the electrolyte layer (solid black line) and the material of the support structure (320) in Fig. 3. Accordingly, Appellants' specification explains that "[e]ach cell (300) generally includes a pore (150), *a portion comprising both alumina and electrolyte impurities (310)*, and a portion comprising relatively pure alumina (320)." (Appellants' specification, paragraph 0028) (emphasis added).

Consequently, Figs. 2 and 3, and the supporting paragraphs of the specification, clearly describe the claimed subject matter "wherein each pore comprises a layer in which

PAGE 14/36 * RCVD AT 10/10/2007 6:20:47 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-3/7 * DNIS:2738300 * CSID:18015727666 * DURATION (mm-ss):07-46

said electrolyte is mixed with a material of said substrate, said layer being between said electrolyte said substrate," e.g., each pore includes "a portion comprising both alumina and electrolyte impurities (310)."

It is unclear from the recent Office Action why these portions of Appellants' specification, e.g., Figs. 2 and 3 and paragraphs 0027 and 0028, are not a sufficient written description in support of claim 78 under § 112, first paragraph. Appellants would like to point out that a "written description" in the specification supporting a particular claim need *not* be a verbatim recitation of the claim language. Rather, as explained in MPEP § 2163.02, written description can be provided "using such descriptive means as words, structures, figures, diagrams, and formulas." *Lockwood v. American Airlines, Inc.*, 107 F.3d 1565, 1572, 41 USPQ2d 1961, 1966 (Fed. Cir. 1997). Because at least Figs. 2 and 3 and paragraphs 0027 and 0028 of Appellants' specification do provide a supporting written description for claim 78, the rejection of claim 78 under 35 U.S.C. § 112, first paragraph, should not be sustained.

<u>(2) Claim 58 complies with 35 U.S.C. § 112, second paragraph:</u>

Claim 58 recites:

> An apparatus comprising:
> a fuel cell configured for providing power, said fuel cell comprising:
> a support substrate supporting a solid cathode material deposited on a first side of said substrate, a solid anode material deposited on a second side of said substrate and an electrolyte; and
> a plurality of pores formed through said substrate, said pores having a size and shape formed in accordance with a pre-selected desired porosity.

According to the recent Office Action, "[i]t is unclear to the Examiner as to what constitutes 'pre-selected desired' porosity." (Office Action, p. 4). Appellants respectfully submit that no actual basis for rejecting claim 58 under 35 U.S.C. § 112 is given in this statement.

There is no reason why the "pre-selected desired porosity should be unclear.

Appellants' specification clearly explains the concept of a "pre-selected desired porosity."

> The fabrication process may begin with determining the desired initial porosity characteristics of the supports structure (step 400). Average pore diameter varies with the anodization voltage used during the formation of anodic alumina. In addition, other factors such as the nature of the anodization electrolyte, electrolyte concentration, and tempore of the anodization may affect the pore diameter. Accordingly, a larger anodization voltage may be applied to the aluminum substrate where a larger average pore size is desired. Further, during formation porosity characteristics can be varied as the substrate is grown, thereby allowing for establishment of pore morphology including a plurality of pore sizes and for change in pore size with respect to the direction of substrate growth. Thus once the desired pore morphology has been determined (step 400), it may be necessary to calculate the anodization voltage profile necessary for the process to achieve the desired pore morphology (step 410).

(Appellants' specification , paragraph 0029).

Consequently, despite being unclear to the Examiner, claim 58 is not indefinite and is clearly explained and supported in Appellants' specification. Therefore, the rejection of claim 58 under 35 U.S.C. § 112, second paragraph, should not be sustained.

<u>(3) Claims 49, 51, 58, 59, 65, 66, 68, 69, 76, 77, and 78 are Patentable over Agruss:</u>

<u>Claim 49:</u>

Claim 49 recites:

> A fuel cell comprising:
> a ceramic support substrate supporting a cathode, anode and electrolyte; and
> a plurality of pores formed through said substrate, *said pores having a size that varies in diameter through a thickness of said substrate.*

(Emphasis added).

In contrast, to claim 49, Agruss does not teach or suggest a fuel cell comprising a porous substrate, "said pores having a size that varies in diameter through a thickness of said substrate." Moreover, the recent Office Action fails to address how or where Agruss is thought to teach or suggest this subject matter of claim 49.

"A claim is anticipated [under 35 U.S.C. § 102] only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987) (emphasis added). See M.P.E.P. § 2131. For at least these reasons, this rejection of claim 49 should not be sustained.

Claim 51:

Claim 51 recites:

> A fuel cell comprising:
> a support substrate supporting a cathode, anode and electrolyte; and
> a plurality of pores formed through said substrate,
> wherein *said pores vary in diameter by tapering to a narrow point between two openings, both openings being larger than said narrow point.*

(Emphasis added).

In contrast, to claim 51, Agruss does not teach or suggest a fuel cell comprising a porous substrate "wherein said pores vary in diameter by tapering to a narrow point between two openings, both openings being larger than said narrow point."

With regard to claim 51, the recent Office Action argues that "the pores will necessarily 'vary in diameter by tapering to a narrow point between two openings' where one pore connects to another pore." (Office Action, p. 5). This argument is difficult to follow because Agruss does not teach that pores connect to other pores.

Apparently, the Examiner is arguing that the tapering pores recited in claim 51 are somehow inherent in Agruss. Appellants disagree and submit that there is nothing on the record leading to such an unreasonable conclusion.

"To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it

would be so recognized by persons of ordinary skill.' 'Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" *In re Robertson*, 49 USPQ2d 1949, 1950 (Fed. Cir. 1999) (citations omitted). "[T]he examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic *necessarily* flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (BPAI 1990) (emphasis in original); see also, MPEP § 2112 (quoting Levy). Clearly, the recent Office Action has failed to meet this standard with regard to claim 51.

"A claim is anticipated [under 35 U.S.C. § 102] only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987) (emphasis added). See M.P.E.P. § 2131. Because Agruss does not teach or suggest the tapering pores recited in claim 51, this rejection of claim 51 should not be sustained.

<u>Claim 58:</u>

Claim 58 recites:

> An apparatus comprising:
> a fuel cell configured for providing power, said fuel cell comprising:
> a support substrate supporting *a solid cathode material* deposited on a first side of said substrate, *a solid anode material* deposited on a second side of said substrate and an electrolyte; and
> a plurality of pores formed through said substrate, said pores having a size and shape formed in accordance with a pre-selected desired porosity.

(Emphasis added).

In contrast, Agruss fails to teach or suggest the claimed porous substrate supporting a *solid* cathode material and a *solid* anode material. In this regard, reference is made to Appellants' originally-filed specification at, for example, paragraph 0039.

To the contrary, Agruss teaches away from this subject matter with a very different fuel cell chemistry in which the electrodes are *liquid*. (Agruss, col. 2, lines 25-30). Clearly, one of skill in the art can tell the difference between a solid electrode material, as claimed, and a liquid electrode material, as taught by Agruss.

On this point, the recent Office Action unreasonably argues that "potassium and thallium are solid materials because at temperature 173 C or below, thallium is solid (3:5-15). Thus, when the fuel cell is starting up from room temperature to its operating temperature, the fuel cell of Agruss would read on the instant claim limitations of 'a solid cathode material' and 'a solid anode material.'" (Office Action, p. 15). This argument completely ignores the clear and explicit teachings of Agruss.

Agruss does not teach or suggest a pure thallium or pure potassium electrode that might be solid at room temperature. Agruss teaches ***solutions*** which are clearly liquid, even at room temperature, and which merely contain, in solution, potassium and thallium. "A liquid potassium rich ***solution*** of potassium and thallium in the upper chamber 10 forms a negative electrode while a thallium rich ***solution*** of liquid potassium and thallium in the lower chamber 12 forms a positive electrode." (Agruss, col. 2, lines 25-30) (emphasis added). Consequently, it is utterly unreasonable, as the Office Action has attempted, to suggest that the liquid electrodes taught by Agruss are somehow solid despite the clear statements of Agruss to the contrary.

Agruss fails to teach or suggest the claimed porous substrate supporting a *solid* cathode material and a *solid* anode material. "A claim is anticipated [under 35 U.S.C. § 102]

only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987) (emphasis added). See M.P.E.P. § 2131. For at least these reasons, the rejection of claims 58 and 59 should not be sustained.

<u>Claims 68 and 69:</u>

Appellants note that claims 68 and 69 depend from independent claim 49, which is not included in this rejection based on Agruss. Consequently, the inclusion of claims 68 and 69 in this rejection is clearly improper and cannot be sustained

<u>Claim 76:</u>

Claim 76 recites "wherein said fuel-cell is a single chamber fuel cell." In contrast, Agruss clearly does not teach or suggest this subject matter. Agruss does not teach or suggest the single chamber fuel cell recited in claim 76. Understanding that Agruss teaches liquid electrodes, rather than solid electrodes, it would be impossible for Agruss to combine the liquid anode, liquid cathode, fuel and oxidant in a single chamber as recited in claim 76 and have a functional device. For at least these additional reasons, this rejection of claim 76 should not be sustained.

<u>Claim 78</u>:

Claim 78 recites "wherein each pore comprises a layer in which said electrolyte is mixed with a material of said substrate, said layer being between said electrolyte said substrate." In this regard, the final Office Action refers to Agruss at col. 3, lines 1-5. (Action of 12/15/06, p. 4). At this point, Agruss teaches that the potassium chloride electrolyte is

molten at the operating temperatures of the fuel cell. The Office Action then appears to make the wholly unsupported assumption that the molten potassium chloride mixes or alloys with the alumina material of the separator (14) in a manner read on by claim 78. However, there is no such teaching or suggestion in Agruss, nor is such an assumption reasonable. For at least these additional reasons, this rejection of claim 78 should not be sustained.

<u>(4) Claims 49, 58, 68, 70-72, 74, 75, 78-81, 83 and 84 are patentable over Ito:</u>

<u>Claim 49:</u>

Claim 49 recites:

> A fuel cell comprising:
> a ceramic support substrate supporting a cathode, anode and electrolyte; and
> a plurality of pores formed through said substrate, *said pores having a size that varies in diameter through a thickness of said substrate.*

(Emphasis added).

In contrast, Ito does not teach or suggest this subject matter. Ito does not teach or suggest a ceramic support substrate with pores formed through the substrate having a size that varies in diameter through the thickness of the substrate. Moreover, the recent Office Action fails to explain how or where Ito teaches such subject matter.

According to the Office Action, "Ito discloses a fuel cell with a solid electrolyte film being formed on a substrate made of flat porous alumina substrate. ... The Examiner notes that the pores of the alumina substrate necessarily vary in diameter through a thickness of said substrate." (Office Action, p. 5). Again, the Examiner is making an inherency argument with no support whatsoever in the cited prior art.

As noted above, "[t]o establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.'" *In re Robertson*, 49

USPQ2d 1949, 1950 (Fed. Cir. 1999) (citations omitted). "[T]he examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic *necessarily* flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (BPAI 1990) (emphasis in original); see also, MPEP § 2112 (quoting Levy).

Clearly, there is no reasonable basis on the record for reading into Ito the subject matter of claim 49, as the Office Action attempts to do. "A claim is anticipated [under 35 U.S.C. § 102] only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987) (emphasis added). See M.P.E.P. § 2131. For at least these reasons, this rejection of claim 49 should not be sustained.

Claim 58:

Claim 58 recites:

> An apparatus comprising:
> a fuel cell configured for providing power, said fuel cell comprising:
> a support substrate supporting a solid cathode material deposited on a first side of said substrate, a solid anode material deposited on a second side of said substrate and an electrolyte; and
> a plurality of pores formed through said substrate, *said pores having a size and shape formed in accordance with a pre-selected desired porosity.*

(Emphasis added).

With regard to claim 58, the recent Office Action makes the unsupported statement that "the pores [taught by Ito] have a size and shape formed in accordance with a pre-selected desired porosity because the porosity has been preselected." (Office Action, p. 5). Appellants respectfully disagree.

As explained above, Appellants' specification explains

> The fabrication process may begin with determining the desired initial porosity characteristics of the supports structure (step 400). Average pore diameter varies with the anodization voltage used during the formation of anodic alumina. In addition, other factors such as the nature of the anodization electrolyte, electrolyte concentration, and tempore of the anodization may affect the pore diameter. Accordingly, a larger anodization voltage may be applied to the aluminum substrate where a larger average pore size is desired,. Further, during formation porosity characteristics can be varied as the substrate is grown, thereby allowing for establishment of pore morphology including a plurality of pore sizes and for change in pore size with respect to the direction of substrate growth. Thus once the desired pore morphology has been determined (step 400), it may be necessary to calculate the anodization voltage profile necessary for the process to achieve the desired pore morphology (step 410).

(Emphasis added).

In contrast, Ito does not teach or suggest any determination of a desired porosity before the pores in a substrate are formed and then forming the pores "in accordance with a pre-selected desired porosity," as claimed. The Office Action provides no citation to support the unreasonable assertion that Ito somehow teaches the subject matter of claim 58.

"A claim is anticipated [under 35 U.S.C. § 102] only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987) (emphasis added). See M.P.E.P. § 2131. For at least these reasons, this rejection of claim 58 should not be sustained.

<u>(5) Claims 52-57 are Patentable over Agruss and Pekala:</u>

<u>Claim 52</u>:

Claim 52 depends from claim 49 and recites "wherein said pores branch within said substrate." Appellants note that claim 49 specifies that the branching pores are in a *ceramic* substrate.

With regard to claim 52, the Office Action refers to the teachings of Pekala. (Office Action, p. 7. However, as noted above, Pekala teaches pores in a polymer web and not in a ceramic substrate. There is no reference of record that teaches or suggests the claimed pores that branch within a *ceramic* substrate as recited in claim 52.

Under the analysis required by *Graham v. John Deere*, 383 U.S. 1 (1966) to support a rejection under § 103, the scope and content of the prior art must first be determined, followed by an assessment of the differences between the prior art and the claim at issue in view of the ordinary skill in the art. In the present case, the scope and content of the prior art, as evidenced by Agruss and Pekala, did not include the claimed pores that branch within a ceramic substrate.

This difference between the claimed subject matter and the cited prior art is significant because, as noted in Appellants' specification, the branching allows one to better control the desired porosity including have a greater number of pore openings on one side of the substrate than the other. This advantage appears not have been known or available in the cited prior art.

Consequently, Agruss and Pekala will not support a rejection of claim 52 under 35 U.S.C. § 103(a) and *Graham*. Therefore, the rejection of claim 52 and its dependent claims should not be sustained.

Claim 53:

Claim 53 recites "wherein branching of said pores results in a greater number of pore openings on a first side of said substrate than on a second side of said substrate." Again, this is with respect to a ceramic substrate. For the reasons given above with respect to claim 52,

the combination of Agruss and Pekala fails to teach or suggest this subject matter and the rejection of claim 53 should not be sustained.

Claim 57:

Claim 57 recites "wherein said substrate comprises a second plurality of substantially uniform pores formed through said substrate wherein an average size of said second plurality of pores is smaller than said first plurality of pores." Again, this is with respect to a ceramic substrate.

None of the cited prior art references teach or suggest two pluralities of pores where an average size of one plurality of pores is smaller that that of the other plurality of pores. For at least this additional reason, the rejection of claim 57 should not be sustained.

(6) Claims 60-64 and 67 are patentable over Agruss and Pekala:

Appellants note that claims 60-64 and 67 depend from independent claim 58, which was not included in this rejection based on a combination of the teachings of Agruss and Pekala. Consequently, the inclusion of claims 60-64 and 67 in this rejection without their independent claim is clearly improper and cannot be sustained.

(7) Claims 52-57 are patentable over Ito and Pekala:

This rejection is entirely redundant of Grounds of Rejection No. 5, addressed above. Again, the Examiner seeks to rely on Pekala for a teaching of a ceramic substrate with pores that branch within the substrate (claim 52). As demonstrated above, Pekala does not teach or suggest this subject matter because Pekala does not teach a ceramic substrate. Therefore, for

the reasons given above with reference to claims 52, 53 and 57, this rejection should not be sustained

(8) Claims 60-64 and 67 are patentable over Ito and Pekala:

This rejection is entirely redundant of Grounds of Rejection No. 6, addressed above. Appellants note that claims 60-64 and 67 depend from independent claim 58, which was not included in this rejection based on a combination of the teachings of Ito and Pekala. Consequently, the inclusion of claims 60-64 and 67 in this rejection without their independent claim is clearly improper and cannot be sustained.

(9) Claim 76 is patentable over Ito and Hibino:

This rejection is respectfully traversed for at least the same reasons given above in favor of independent claim 58. Therefore, this rejection of claim 76 should not be sustained.

(10) Claim 73 is patentable over Ito and Doshi:

This rejection is respectfully traversed for at least the same reasons given above in favor of independent claim 49. Therefore, this rejection of claim 73 should not be sustained.

(11) Claim 82 is patentable over Ito and Doshi:

This rejection is respectfully traversed for at least the same reasons given above in favor of independent claim 58. Therefore, this rejection of claim 82 should not be sustained.

In view of the foregoing, it is submitted that the final rejection of the pending claims is improper and should not be sustained. Therefore, a reversal of the Rejection of July 11, 2007 is respectfully requested.

Respectfully submitted,

DATE: October 10, 2007

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I hereby certify that this correspondence is being transmitted to the Patent and Trademark Office facsimile number **571-273-8300** on **October 10, 2007**. Number of Pages: **36**

Rebecca R. Schow

VIII. CLAIMS APPENDIX

1-48. (cancelled)

49. (previously presented) A fuel cell comprising:

a ceramic support substrate supporting a cathode, anode and electrolyte; and

a plurality of pores formed through said substrate, said pores having a size that varies in diameter through a thickness of said substrate.

50. (original) The fuel cell of claim 49, wherein said electrolyte is deposited in said pores.

51. (previously presented) A fuel cell comprising:

a support substrate supporting a cathode, anode and electrolyte; and

a plurality of pores formed through said substrate,

wherein said pores vary in diameter by tapering to a narrow point between two openings, both openings being larger than said narrow point.

52. (original) The fuel cell of claim 49, wherein said pores branch within said substrate.

53. (previously presented) The fuel cell of claim 52, wherein branching of said pores results in a greater number of pore openings on a first side of said substrate than on a second side of said substrate.

54. (original) The fuel cell of claim 53, wherein said anode is disposed on said first side of said substrate and said cathode is disposed on said second side of said substrate.

55. (previously presented) The fuel cell of claim 49, wherein said pores are substantially uniform in size and shape.

56. (original) The fuel cell of claim 49, wherein said substrate comprises alumina.

57. (previously presented) The fuel cell of claim 55, wherein said substrate comprises a second plurality of substantially uniform pores formed through said substrate wherein an average size of said second plurality of pores is smaller than said first plurality of pores.

58. (previously presented) An apparatus comprising:

a fuel cell configured for providing power, said fuel cell comprising:

a support substrate supporting a solid cathode material deposited on a first side of said substrate, a solid anode material deposited on a second side of said substrate and an electrolyte; and

a plurality of pores formed through said substrate, said pores having a size and shape formed in accordance with a pre-selected desired porosity.

59. (original) The apparatus of claim 58, wherein said electrolyte is deposited in said pores.

60. (original) The apparatus of claim 58, wherein said pores vary in diameter along a thickness of said substrate.

61. (original) The apparatus of claim 58, wherein said pores branch within said substrate.

62. (original) The apparatus of claim 61, wherein branching of said pores results in a greater number of pore openings on a first side of said substrate than on a second side of said substrate.

63. (original) The apparatus of claim 62, wherein said anode is disposed on said first side of said substrate and said cathode is disposed on said second side of said substrate.

64. (original) The apparatus of claim 58, wherein said pores are formed in parallel through said substrate.

65. (original) The apparatus of claim 58, wherein said substrate comprises a ceramic.

66. (original) The apparatus of claim 58, wherein said substrate comprises alumina.

67. (original) The apparatus of claim 58, wherein said substrate comprises a second plurality of pores formed through said substrate wherein an average size of said second plurality of pores is smaller than said first plurality of pores.

68. (previously presented) The fuel cell of claim 49, wherein said pores provide an open passageway through said substrate with said electrolyte being deposited on sides of interiors of said pores.

69. (previously presented) The fuel cell of claim 68, wherein each pore comprises a layer in which said electrolyte is mixed with a material of said substrate, said layer being between said electrolyte said substrate.

70. (previously presented) The fuel cell of claim 49, wherein said cathode comprises perovskite.

71. (previously presented) The fuel cell of claim 70, wherein said cathode comprises lanthanum manganite.

72. (previously presented) The fuel cell of claim 49, wherein said anode comprises a ceramic/metal composite.

73. (previously presented) The fuel cell of claim 72, wherein said anode comprises nickel and yttria-stabilized zirconia cermet.

74. (previously presented) The fuel cell of claim 49, wherein said electrolyte comprises at a zirconia-based electrolyte.

75. (previously presented) The fuel cell of claim 74, wherein said electrolyte comprises at least one of yttria-stabilized zirconia, gadolinium-doped ceria, $Ba_2In_2O_5$, or a (strontium, magnesium)-doped $LaGaO_3$ (LSGM).

76. (previously presented) The apparatus of claim 58, wherein said fuel-cell is a single chamber fuel cell.

77. (previously presented) The apparatus of claim 58, wherein said pores provide an open passageway through said substrate with said electrolyte being deposited on sides of interiors of said pores.

78. (previously presented) The apparatus of claim 77, wherein each pore comprises a layer in which said electrolyte is mixed with a material of said substrate, said layer being between said electrolyte said substrate.

79. (previously presented) The apparatus of claim 58, wherein said cathode comprises perovskite.

80. (previously presented) The apparatus of claim 79, wherein said cathode comprises lanthanum manganite.

81. (previously presented) The apparatus of claim 58, wherein said anode comprises a ceramic/metal composite.

82. (previously presented) The apparatus of claim 81, wherein said anode comprises nickel and yttria-stabilized zirconia cermet.

83. (previously presented) The apparatus of claim 58, wherein said electrolyte comprises at a zirconia-based electrolyte.

84. (previously presented) The apparatus of claim 83, wherein said electrolyte comprises at least one of yttria-stabilized zirconia, gadolinium-doped ceria, $Ba_2In_2O_5$, or a (strontium, magnesium)-doped $LaGaO_3$ (LSGM).

IX. Evidence Appendix

None

X. Related Proceedings Appendix

None

XI. Certificate of Service

None